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BIODIVERSITY IN THE HIGH-MOUNTAIN FLORA OF THE UKRAINIAN CARPATHIANS: CONSERVATION, PROTECTION AND REINTRODUCTION

Зиман С.М., Дербак М.Ю., Булах О.В. **Біорізноманіття у високогірній флорі Українських Карпат: збереження, охорона, реінтродукція.** – Природа Карпат: науковий щорічний Карпатського біосферного заповідника та Інституту екології Карпат НАН України. – 2017. – №1. – С. 4–9.

В результаті багаторічних досліджень рідкісних і зникаючих видів судинних рослин у високогірній флорі Українських Карпат ми проаналізували їх сучасний стан, екологічні й фітоценотичні особливості, також зростання більшості з них в угрупованнях, що включають від 5 до 10 (іноді 15-20) рідкісних видів. Ми підтвердили сучасні погляди щодо розгляду таких угруповань як «гарячих точок» і їх розгляду як важливих осередків збереження різноманіття рослин. Нами зроблено порівняння участі рідкісних високогірних видів судинних рослин у флорах Українських Карпат і Балкан. Крім того, ми додали результати порівняльного вивчення рідкісних рослин у природних біотопах і на експериментальній ділянці Національного природного парку «Синевир», маючи на меті реінтродукувати частину таких рослин у природні угруповання.

Ключові слова: рідкісні і зникаючі види, судинні рослини, високогірна флора, Українські Карпати, Балкани, реінтродукція

Ziman S., Derbak M., Bulakh O. Biodiversity in the High-Mountain flora of the Ukrainian Carpathians: conservation, protection and reintroduction

As a result of the long-standing of the rare and endangered species of the Vascular Plants in the High-Mountain Flora of the Ukrainian Carpathians, we discussed their modern state, ecological and phytocoenotic peculiarities and growing of most of them in the communities including 5 to 10 (or more) species. We follow the modern view in regarding the such communities as the «hot spots» and considering them as the important sectors of the of the preservation of the plant diversity. Besides, we briefly compared the participation of the above plants in the floras of the Ukrainian Carpathians and Balkan. Additionally we implemented the comparative study of the rare species at the nature biotopes and the experimental plot in the NPP Synevyr, mainly for future reintroduction into the natural communities.

Key words: rare and endangered species, vascular plants, alpe flora, Ukrainian Carpathians, Balkan, reintroduction

The Convention of Biological Diversity, signed in Rio Summit in 1992, in Valencia in 1994 and Pan-European Strategy of Biological and Landscape Diversity accepted in Sofia at the International Meeting «Environment for Europe» in 1995, aimed to protect the rare species

and landscapes. Afterwards the above mentioned proposals were summarised in Strasbourg by the Council of Europe as «Convention on the conservation of European Wildlife and natural habitats» (Synge, 2000). Therefore, we regard the problem of the conservation of the



endangered and threatened Vascular Plants, especially in the Carpathians and Balkan, as the very actual, and we try to do our best to promote their protection and conservation.

Subjects and methods of research

Within the High-Mountain Flora of the Ukrainian Carpathians there are ca. 1000 taxa (species and subspecies) of the Vascular Plants within which about 200 taxa are rare and ca. 100 taxa endemic (Chopik, 1976; Stoyko, Tassenkevich, 1993; Malinovski et al., 2002; Ziman, Gamor, 2009 and others). During a lot of years we executed the concise analysis of the modern state of about 60 rare (mainly endangered) species of the above mentioned plants (Ziman, 1964, 1997; Ziman et al., 1988–2013). We published a part of our results in the monograph on biodiversity of the Carpathian biosphere Reserve (1997) and treatments on 25 rare High-Mountain species in the last version of the «Red book of Ukraine» (2009), and here we intend to extend and generalize our results with the accent on perspectives of preservation and protection of the rare plants.

Our treatment is based on the results of the field research, but also on the herbarium and literature data. We studied the rare species of plants within the High-Mountain communities mainly in Ukraine, but also in the Southern Carpathians in Romania and in Balkan in Serbia and Montenegro. As a result, we discussed the geographic-ecological, coenotic and biomorphological peculiarities of ca. 50 very rare species. Besides, we discussed the results of the population study of 20 rare species in limits of the Project from the «International Global Ecologic Fund» and the treatments of 25 rare species published in the «Red Book of Ukraine. Plant World» (2009). Besides, recently we discussed the results of introduction of the rare Vascular Plants from the High-Mountain flora of the Ukrainian Carpathians at the experimental plot in the National Nature Park Synevyr situated in Ukraine, Transcarpathian Region (Ziman, Derbak, 2012). We used in this manuscript the generally accepted methods of the biomorphological, population and phytocoenotic study.

Discussion of results

Our list of the studied in details model taxa included 24 species belonging to the highest categories of rareness (CR – critically endangered and EN – endangered): *Achillea schurii* Sch. Bip., *Aconitum hosteanum* Schur, *A. jacquinii* Rchb., *A. nanum* Baumg., *Anemone narcissiflora* L., *Anthemis carpatica* Waldst. & Kit. ex Willd., *Aquilegia nigricans* Baumg., *Aster alpinus* L., *Astragalus krajinae* Domin, *Biscutella laevigata* L., *Coeloglossum alpinum* Schur, *Draba aizoides* (L.) J.F.Gmel., *Gentiana acaulis* L., *G. laciniata* Kit. et Kanitz, *G. verna* L., *Primula halleri* J.F.Gmel., *P. minima* L., *P. verna* L., *Ranunculus thora* L., *Rhodiola rosea* L., *Salix alpina* Scop., *S. retusa* L., *Saxifraga androsacea* L., *Veronica aphylla* L. A part of the above mentioned results of our study is published (Ziman et al., 2009), and at present time we discussed the outlook on the conservation of the endangered High-Mountain Vascular Plants from the other points of view included the «Habitat concept of the biodiversity protection» (Kagalo & Prots, 2012).

It is expedient to note that almost all threatened High-Mountain species are heliophytes and oreophytes which grow in the alpine belt mainly at the stone or rocky localities (frequently calcareous). For many of them we noted a small size of populations, mainly isolated. Therefore, a part of these populations look like the separate fragments. Moreover, most of them are characterized by the low ability of the reproductive propagation, not complete age spectra, low indices of renewal and replacing (Ziman, 1997 and others).

The analysis of ca. 100 floristic lists of the High-Mountain communities with the participation of the above mentioned rare species in the Ukrainian Carpathians (Malynovski, Kriczfalusy, 2002, but also own data) has shown the presence of the rather limited number of the constant species within them (about 50 species only) which form the base of the peculiar High-Mountain floristic complexes. On our opinion, the historical development of most High-Mountain species



took place exactly in their limits (Ziman, Gamor, 2009).

As a result of the long-standing monitoring on the High-Mountain plants in the Ukrainian Carpathians, we regard the High-Mountain communities including 5 to 10 (sometimes more) rare species as the «hot spots» being the important sectors of the endangered species diversity and integrity (Medail, Quesel, 1997). According to our data (Ziman et al., 2005–2009), there are more than 20 «hot spots» close to summits of Svidovets, Chernogora, Marmarosh, Chyvchyn and Gorgan Ranges, and most of them are rare, endemic or relict phytocoenoses. The greatest communities are the alpine ones occurring at the upper part of the Svidovets Range (Dragobrat, Bliznitsa, Herishaska and others). They are situated mainly on the calcareous uncoverings (ca. 30 rare species including CR *Antennaria carpatica*, *Aquilegia nigricans*, *Aster alpinus*, *Astragalus krajinae*, *Biscutella laevigata*, *Draba aizoides*, *Leontopodium alpinum* Cass., *Primula halleri* J.F.Gmel., *Saxifraga androsacea*, *Veronica aphylla* and others). Meanwhile, the high concentration of the rare species is characteristic for communities close to the summits of Petros (Chernogora, ca. 25 rare species including CR *Carex bicolor* All., *Minuartia zarecznyi* (Zapal.) Klokov, *Ranunculus thora*, *Salix alpina*, *S. retusa* and others) and Pop Ivan (Marmarosh, ca. 20 rare species including CR *Anthemis carpathica*, *Jovibarba hirta* (L.) Opiz, *Sempervivum marmoreum* Griseb. and others).

Within the High-Mountain communities of the Ukrainian Carpathians we regard the such associations situated close to the summit of Bliznitsa, Svidovets (three «trumpets» of Dragobrat, ca. alt. 1800 m) as the most valuable: *Festucetum amethystinae* (Domin) Coldea 1984, *Festucetum carpaticae* Domin 1930, *Festucetum pictae* Krajina 1933, *Achilleo (schurii)-Dryadetum* (Beldie) Coldea 1984, *Cystopteridetum fragilis* Oberd. 1938, *Salicetum herbaceae* Br.-Bl. 1931, *Saxifrago (paniculatae)-Festucetum versicoloris* Wall. 1933 in which about 50 taxa of the rare

Vascular plants (including ca. 20 endemic species) are present (Ziman et al., 2010). The communities on the north-eastern slopes below the summit of Petros, Chernogora (alt. ca. 1800 m) are valuable too because of including in them about 40 species of the rare plants (more than 20 endemic species), and most of them belong to the associations *Festucetum amethystinae*, *Festucetum carpaticae*, *Festucetum versicoloris* Val. 1933, *Thymo-Festucetum amethystinae* Kricsfalusy et Malinovski 2000, *Seslerieto-Caricetum (sempervirentis)* Kricsfalusy et Malynovski 2000, *Cetrario-Juncetum trifidi* Malynovski et Cricsfalusy and *Salicetum herbaceae* Br.-Bl. 1931 (Ziman et al., 2009).

The protection and conservation of most «hot spots» within the High-Mountain Flora of the Ukrainian Carpathians has to be the urgent task of the preservation of the plant diversity of the Ukrainian Carpathians.

The disappearing plants, especially having solitary localities or non-sufficiently studied, merit the peculiar attention, and we confirm this thesis by our data on the extinct *Primula farinosa* L. In 1962 we noted the unique locality of *P. farinosa* in the Ukraine (Gorgan Range, close Jasinja in the Transcarpatian Region), and we studied this species at this locality during the next four years. Unfortunately, after the melioration this species disappeared from Gorgan and the flora of Ukraine (Ziman, 1964; Ziman, Vainagyi, 1991) despite of our attempts to hinder it. The next endangered species *Gentiana verna* L. grew together with *P. farinosa* but at present time it is disappearing – as a result of the economic activity of people. After critical examination of literature (Coldea, Plamada, 1976; Haberova, 1968, etc.), we concluded that both *P. farinosa* and *G. verna* are the relict circumpolar arctic-alpine taxa disjunctively distributed in Eurasia and North America, and in Europe their areas include the Alps, Carpathians and Balkan. Their unique phenomenon is the growing of both species everywhere in the rare relict association *Caricetum davallianae* Dutoit 1924 (Ziman et al., 2001).

The next important question is the discussion of the ecological-geographical patterns of



the rare species in the Ukrainian Carpathians, other Regions of Europe and the whole world. As a result of the appropriate analysis, we have to note that about 45 studied rare species in the High-Mountain flora of the Ukrainian Carpathians are the alpine-subalpine plants and the next ca. 25 species are the arctic-alpine plants. The valuable peculiarities of most studied rare species (ca. 60 taxa out of 70) are their disjunctive areas which include the Alps and a part the Balkan mountain Ranges. Within them there are ca. 20 relict species which are characterized by the wide disjunctions.

Within the rare species in common to the High-Mountain flora of the Ukrainian Carpathians and Balkan, we note few taxa (*Anemone narcissiflora* L., *Aster alpinus*) distributed in the all countries of Balkan, meanwhile, other species occur only in Bulgaria (*Gentiana acaulis* L., *G. punctata* L., *G. verna*, *Narcissus angustifolius* Curtis, *Pedicularis oederi* Vahl, *Primula halleri* F.J Gmel., *Pulsatilla scherfelii* (Ullep.) Skalicky, *Rhododendron myrtifolium* Schott et Kotschy and others) or Serbia (*Achillea schurii*, *Gentiana laciniata* Kit. ex Kanitz, *Leontopodium alpinum*) and Montenegro (*Biscutella laevigata*) (Beck et al., 1967; Gajic, 1984; Lakusic et al., 2004; Micevski, 1985; Peev et al., 2011; Stevanovic, 1999; Trpn, Vres, 1995 and others).

We should like to note that a lot of High-Mountain taxa are the endangered in Ukraine and are less rare in other parts of the Carpathians (Ziman et al., 1998). For instance, within 80 rare species in common to the High-Mountain floras of Ukraine and Romania, about 20 species (*Aster alpinus*, *Biscutella laevigata*, *Campanula carpatica* Jacq., *Veronica alpina* L. and others) are endangered in Ukraine but only vulnerable in Romania. Meanwhile, in the flora of Romania the species more rare than in the flora of Ukraine are few (*Aconitum jacquinii*, *Gentiana acaulis*, *G. lutea* L., *Rhodiola rosea* and some others).

On the pattern of the flora of the Ukrainian Carpathians we briefly discussed the actual questions of the conservation of the rare and vanishing plants *in situ* and *ex situ* (Ziman et al., 2012). Meanwhile, recently we began to re-

alize the comparative study of rare species in the natural populations and at the experimental plot for the elaboration of the concrete proposals to improve the state of their biotopes and their later re-introduction into the natural biotopes (*ex situ*).

We noted that several years ago we realized the first attempt to re-introduce the above mentioned extinct species *Primula farinosa* from the adjacent floras of Slovakia (Brezno, 1998) and Romania (Tuzhnadj, 2000) to its initial locality close Jasinja but unfortunately we were unsuccessful.

Nevertheless, in 2010 we began to create the experimental plot of the rare species in the National Nature Park Synevyr and in 2010–2013 we introduced there about 40 species from Dragobrat (Svidovets), Petros (Chernogora), Pip Ivan (Marmarosh), Negrovets (Gorgan) and some other High-Mountain localities (Ziman et al., 2012). At present time this collection includes ca. 600 plants belonging to ca. 60 species and a lot of plants grow successfully (including their blossoming, fruiting and propagation). Today the best introducents seem to be *Aconitum firmum* (Rchb.) Gay, *A. nanum*, *Anthemis carpatica*, *Aster alpinus*, *Leontopodium alpinum*, *Narcissus angustifolius* Curt., *Orchidaceae* [*Coeloglossum viride* (L.) Hartm., *Gymnadenia conopsea* (L.) R.Br., *Listera cordata* (L.) R. Br., *Orchis purpurea* Huds., *Traunsteinera globosa* (L.) Rchb., *Oxyria digyna* (L.) Hill, *Potentilla crantzii* G.Beck ex Fritsch., *Rhodiola rosea*, *Scabiosa opaca* Klok. Meanwhile, the results of introduction of *Anemone narcissiflora*, *Aquilegia nigricans*, *Astragalus krajinae*, *Campanula kladniana*, *Gentiana acaulis*, *G. lutea* L., *Rhododendron myrtifolium* and some other species are debatable; and the plants of *Gentiana laciniata* and *G. verna* perished.

Conclusions

We presented the brief results of the analysis of the modern state of the rare (mainly endangered or threatened) species of the Vascular Plants in the High-Mountain flora of the Ukrainian Carpathians (participants of the modern

«Red book of Ukraine» 2009). We paid attention to occurring of these species mainly in the communities including 5 to 10 (sometimes more) rare species which regard as the «hot spots» and most of them are rare, endemic or relict ones. Therefore, these taxa are frequently considered as the important sectors of the of the preservation of the plant diversity and have to be revealed and conserved *in situ*. Meanwhile, we began to implement the comparative study of the rare species at the experimental plot (*ex situ*) for their subsequent introduction into the natural biotopes.

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